Resilience of steppe vegetation after a dryness cycle in Algeria: Example of Hadj Mechri Commune in the Laghouat Wilaya

Hammouda[1,2] R.F.,Huguenin[3] J., Taugourdeau[3] S., Nedjraoui[2] D.,

[1] Université Djlali Bounaama. Khemis Miliana, 44 250 Algeria
Corresponding author email : hammouda.rachid@yahoo.fr)
[2] Université USTHB, Alger, 16 000 Algeria
[3] UMR SELMET CIRAD, Montpellier, 34 000 France

Keywords: rangeland,functional strategy, resilience, dryness, Algeria

Introduction

The Algerian steppe covers 20 million hectares and it is one of the largest livestock production zones in North Africa. The steppe has been impacted by climatic changes, landuse changes, increasingin demography, and overgrazing over the last 40 years.

It is generally agreed that productivity of the Algerian steppe has declined and this has been confirmed by studies (Nedjraoui and Bedrani, 2008; Salamani *et al*, 2013). This decrease in vegetation is generally explained by the increase of dryness events and by overgrazing. Understanding how vegetation recovers after dryness events will help to devise management practices that avoid overgrazing.The last six years were marked by a severe dryness in 2007 and 2008, followed by a very wet year in 2009, and normal rainfall patterns from 2010 to 2013. The goal of our study was to understand the dynamic of the rangeland vegetation after adryness event.

Material and methods

Our study site was the agro-pastoral commune of Hadj Mechri (65.270 ha) in the Laghouat, Wilaya (Algeria). The region is considered semiarid (P= 315mm year, CV=31%). This commune is representative of the degradation of steppe vegetation over the climatic cycle (2007-2013). It has been registered a low rainfall in 2007 and 2008 (196 mm), a very wet year in 2009 (501 mm) and medium years from 2010 to 2013 (320 mm).
We made 275 phyto-ecological surveys using the method of “points quadras” (Daget et Godron, 1995) between 2007 and 2013. These surveys were used to characterize the vegetal formation and their ecological characteristics (specific contribution, vegetal cover, pastoral value and potential stocking rate). To assess the differences in botanical composition, we projected the Bray Curtis dissimilarities using Nonmetric Multi-Dimensional Scaling (NMDS). We used the two axes of the NMDS as indicators of botanical change and to identify the different vegetal formations. We also used the Raunkiaer classification (1934) and Grime strategies (1977) to describe the vegetation. We also assessed vegetation cover, the cover of sand, the pastoral value and the potential stocking rate. We compared these different variables between the different years using ANOVA followed by a Tukey HSD test.

Results and Discussion

The analysis of the botanical composition confirm that the surveys were made in three different vegetal formations: *Stipa tenacissima L.*, *Lygeum spartum L.* and *Stipagrostis pungens Desf.*. We observe a change in botanical composition during the different years of the surveys with a shift between 2011 and 2012. We have interpreted that these changes were due to a decrease of sable cover and an increase of organic matter. This modification is also correlated with an increase inbiodiversity and a change in Raunkier groups from geophyte to therophyte. Regarding the Grime strategies, the cover of competitor species is higher in the first years of the monitoring at the opposite the cover of ruderal species increase.

It is interesting to notice the time-lap between rainfall and vegetation dynamics. The year 2009 had the highest rainfall (501 mm) over the cycle but the vegetation variables were not different from the dry years. The shift in vegetation was the most important in 2010 when there was an increase of the number of species, vegetal cover and pastoral value, and annual species and a decrease of sand cover (decrease of 91% of the sable cover between 2009 and 2013 in the *Lygeum spartum* formation). The trends remained similar for the three years after 2010 characterized by an average rainfall. Since 2013, the pastoral value is decreasing. It could be due to the increase of ruderals that could be an indication of the increase of anthropic pressure on the vegetation. The dynamics of the different variables of vegetation are represented in the Figure 1.

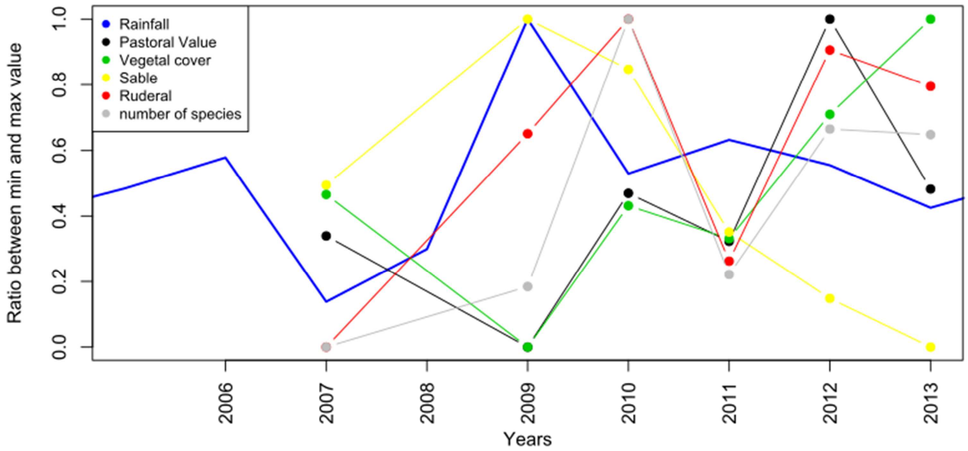


Fig.1, Dynamic of the variables of the vegetation and the rainfall per year. (The x axis represents the years; the Y axis corresponds to the value of the normalized variable (0 for the minimal value of the yearly mean value of the variables and 1 for the maximal value).

The vegetation in our studied site was subject to large rainfall variability, high level of anthropic disturbance with high stationary stocking rate. These factors favored ruderal species and therophytes species. The therophytes species are able to survive the climatic events and grazing due to their quick growth and high seed production (Jauffret and Lavorel, 2003).This overgrazing is also confirmed by the diminution of the pastoral value of 28% between 2012 and 2013 and the diminution of pastoral production.

Conclusion

In this work, we have showed the resilience of the steppe vegetation to a dryness event. We observe an ecological succession of the vegetation. Competitor species were more present during the dry years. A very wet year can stimulate the functioning of the ecosystem. The competitors' species are progressively replaced by ruderal species maybe due to the impact of grazing.

References

Daget Ph., Godron M., 1995. Pastoralisme, troupeau, espaces et société. Hatier ed. Paris. 516 pp.

Grime, J.P., 1977. Evidence for the existence of three primary strategies in plants and its relevance to ecological and evolutionary theory.*American Naturalist* 111, 1169–1194.

Jauffret, S., Lavorel, S., 2003. Are plant functional types relevant to describe degradation in arid, southern Tunisian steppes? J. Veget. Sci. 14, 399–408.

Nedjraoui D., Bédrani S., 2008. La désertification dans les steppes algériennes : causes, impacts et actions de lutte. *VertigO* - V. 8 N° 1 | avril 2008, mis en ligne le 01 avril 2008.

Raunkiaer, C.Oxford, U., ed. 1934. The Life Forms of Plants and Statistical Plant Geography., Oxford University Press. 632 pp.

Salamani M., Kadi Hanifi H., Hirche A, Nedjraoui D. 2013. Évaluation de la sensibilité à la désertification en Algérie. Revue d'écologie 68 (1). 71 - 84.

10TH INTERNATIONAL RANGELAND CONGRESS

SASKATOON, SASKATCHEWAN CANADA | 16-22 JULY 2016

The Future Management of Grazing and Wild Lands in a High-Tech World

PROCEEDINGS
10TH INTERNATIONAL RANGELAND CONGRESS

EDITORS
ALAN IWAASA, H.A. (BART) LARDNER,
MIKE SCHELLENBERG, WALTER WILLMS
AND KATHY LARSON

16-22 JULY 2016
SASKATOON, SK | TCU PLACE

HTTP://2016CANADA.RANGELANDCONGRESS.ORG

Hammouda R.F., Huguenin J., Taugourdeau S., Nedjraoui D., 2016.
Resilience of steppe vegetation after a dryness cycle in Algeria: Example of Hadj Mechri Commune in the Laghouat Wilaya.
In: Proceedings of the 10th International Rangeland Congress, 207 - 209.
http://2016canada.rangelandcongress.org/pdf/papers/X_IRC_Proceedings_Aug2016.pdf

10th International Rangeland Congress July 16-22, 2016

Resilience of steppe vegetation after a dryness cycle in Algeria: *Ex. of Hadj Mechri Commune in the Laghouat Wilaya*

Hammouda[1,2] R.F.,Huguenin[3] J., Taugourdeau[3] S., Nedjraoui[2] D.,

[1] Université Djlali Bounaama. Khemis Miliana, 44 250 Algeria
[2] Université USTHB, Alger, 16 000 Algeria
[3] UMR SELMET CIRAD, Montpellier, 34 000 France

Degraded rangeland of *Stipa tenacissima L.* (2008)

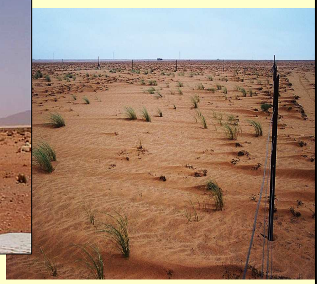
Natural regeneration of *Stipa tenacissima* L. (2012)

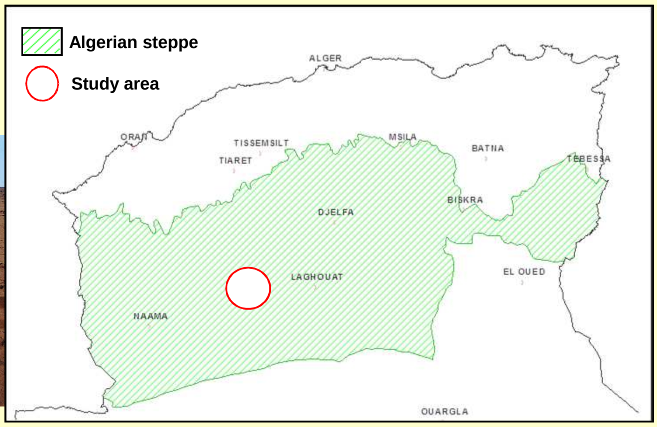
INTRODUCTION

The Algerian steppe has been impacted by climatic changes, land use changes, increasingin demography, and overgrazing over the last 40 years (Nedjraoui & Bedrani, 2008).
Understanding how vegetation recovers after dryness events will help to devise management practices that avoid overgrazing. The goal of our study was to understand the dynamic of the rangeland vegetation after a dryness event.

MATERIALS AND METHODS

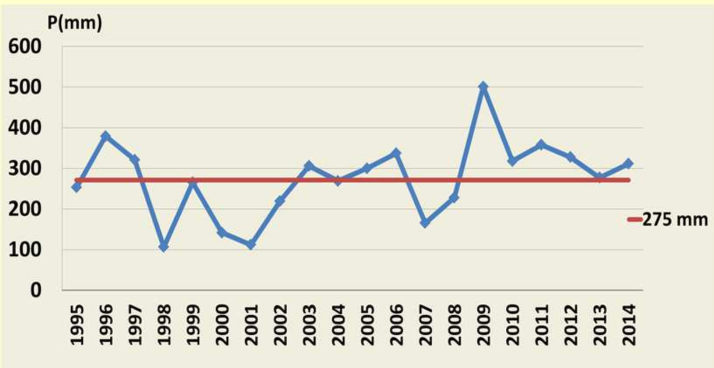
Our study site was the agro-pastoral commune of Hadj Mechri (65.270 ha) in the Laghouat Wilaya. The region is considered semiarid (P= 315mm year). The last six years were marked by a severe dryness in 2007 and 2008, followed by a very wet year in 2009, and normal rainfall patterns from 2010 to 2013.
We made 275 phyto-ecological surveys using the method of "points quadras" between 2007 and 2013.
We projected the Bray Curtis dissimilarities using Nonmetric Multi-Dimensional Scaling (NMDS). We used the Raunkiaer classification (1934) and Grime strategies (1977) to describe the vegetation.
We compared these different variables between the different years using ANOVA followed by a Tukey HSD test.



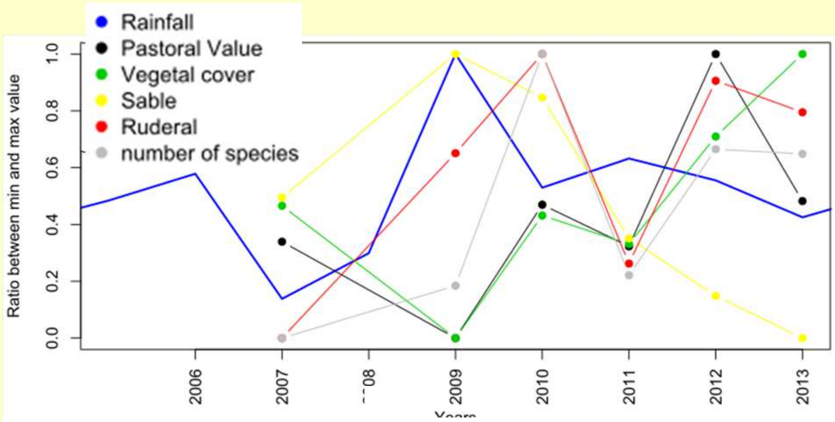


RESULTS AND DISCUSSION

The analysis of the botanical composition confirm that the surveys were made in three different vegetal formations: *Stipa tenacissima L., Lygeum spartum L. and Stipagrostis pungens Desf.*. We observe a change in botanical composition during the different years of the surveys with a shift between 2011 & 2012. This modification is also correlated with an increase in biodiversity and a change in Raunkier groups from geophyte to therophyte.
The cover of competitor species is higher in the first years of the monitoring at the opposite the cover of ruderal species increase. It is interesting to notice the time-lap between rainfall and vegetation dynamics.



Annual rainfall between 1995-2014



Dynamic of the variables of the vegetation and the rainfall per year.

CONCLUSIONS AND IMPLICATIONS

We have showed the resilience of the steppe vegetation to a dryness event. Competitor species were more present during the dry years.
A very wet year can stimulate the functioning of the ecosystem. The competitors' species are progressively replaced by ruderal species maybe due to the impact of grazing.

REFERENCES

- Nedjraoui D & Bedrani S 2008.- La désertification dans les steppes algériennes: causes, impacts et actions de lutte. *Revue électronique en sciences de l'environnement VertigO*, 8: 7-15.
- Grime, J.P., 1977. Evidence for the existence of three primary strategies in plants and its relevance to ecological and evolutionary theory. *American Naturalist* 111, 1169–1194.
-Raunkiaer, C.Oxford, U., ed. 1934. The Life Forms of Plants and Statistical Plant Geography., Oxford University Press. 632 pp.